

SCIENCE

NEW YORK, AUGUST 14, 1891.

THE SPACE-PENETRATING POWER OF LARGE TELESCOPES.¹

UNLESS there is some small star or dimly shining body with a large parallax which has not yet been detected, our nearest neighbor amongst the stars is the double star α Centauri. It is situated about thirty degrees from the southern pole of the heavens, and therefore is not visible in England. The two stars together shine with a light which is a little greater than that of a first magnitude star, for the larger of these twin suns is ranked by Professor Gould as being exactly of the first magnitude of the photometric scale, and the smaller star is of the $3\frac{1}{2}$ magnitude.

According to this photometric scale of magnitudes, which is now universally used, a star of the first magnitude gives just a hundred times as much light as a star of the sixth magnitude. Consequently, if the larger star of the pair, which is known as α^2 Centauri, were removed to ten times its present distance, it would appear as a star of the sixth magnitude; but this would only be the case if there were no loss of light in travelling from its more distant position. If there were any absorption of light in passing through such a vast distance of space it might appear smaller, and would probably not be visible to the naked eye, for few people see stars with their unaided eyes which are ranked as smaller than the sixth magnitude. According to the photometric scale, a star of any magnitude gives about two and a half times as much light as a star of the magnitude immediately below it. Thus a star of the sixth magnitude gives 2.512 times as much light as a star of the seventh magnitude, and a star of the seventh magnitude gives 2.512 times as much light as a star of the eighth magnitude. Consequently a star of the sixth magnitude gives 6.31 times as much light as a star of the eighth magnitude, and 15.85 times as much light as a star of the ninth magnitude, 39.81 times as much light as a star of the tenth magnitude, and 100 times as much light as a star of the eleventh magnitude.

Let us suppose that α^2 Centauri was removed to one hundred times its present distance, then, neglecting the absorption of light in space, it would shine as a star of the eleventh magnitude of the photometric scale, and would only just be visible with a telescope of two and a half inches aperture. This calculation is based on the assumption of Professor C. A. Young (Text Book of General Astronomy, sec. 822) that, for normal eyes, with a good telescope, the minimum visible for a one-inch aperture is a star of the ninth magnitude — an estimate which about corresponds to what might be expected from the diameter of the pupil of the eye.

I have measured the diameter of the pupils of several persons whom I believed to have keen sight, amongst others, the observing eyes of the Rev. T. W. Webb, Mr. Burnham, and the late Dr. H. Draper, and have found that about a quarter of an inch generally corresponds to the maximum dilation of the pupil in viewing faint objects. A telescope

of one inch diameter would consequently collect about sixteen times as much light as would enter the pupil of the unassisted eye, and ought, with a suitable eye-piece, to show stars giving about one-sixteenth the light of a sixth magnitude star just visible to the naked eye. As we have seen above, a sixth magnitude star gives 15.85 times as much light as a ninth magnitude star of the photometric scale. Consequently, neglecting the absorption of light by the lenses, and the reflection from their surfaces, a one-inch telescope ought, with a suitable eye-piece (which collects and sends into the pupil of the eye the whole of the light from the object-glass), to render stars of the ninth magnitude just visible.

The power used with a telescope makes some difference, as it increases the contrast between the brightness of the star and the background on which it is seen, — the light of the background being dimmed by magnification, while the star in a good defining telescope is but slightly dimmed by moderate magnification. Thus Dawes found that he could see a star of the sixth magnitude with a telescope having an aperture of only 0.15 of an inch when a power of $16\frac{1}{2}$ was used. In the case of the one-inch telescope above referred to, the loss of light by absorption and reflection at the surfaces of the lenses seem to be about balanced by the increase of contrast with the background, due to the power employed.

Let us suppose that α^2 Centauri were removed to a thousand times its present distance, then, neglecting the absorption of light in travelling through space, it would appear as a star of the sixteenth magnitude, and would only just be visible with a telescope of 25.12 inches aperture; and if it were removed to 1,585 times its present distance, it would shine as a star of the seventeenth magnitude of the photometric scale, and would only just be visible in a telescope of 39.81 inches aperture. That is, it would not be visible in the great Lick 36-inch refractor.

These calculations are based on the assumption that there is no absorption of light in passing through great distances of space, and also on the assumption that there is no loss of light in passing through such thick lenses. The thickness of the object-glass of the Washington 26-inch refractor at its centre is nearly three inches; thus, the flint glass lens is there 0.96 of an inch thick, while the crown glass lens is 1.88 inches thick at its centre. Such a thickness more than halves the intensity of the emergent pencil; and the loss of light by absorption in passing through the glass near the centre of the Lick object-glass must be considerable. Exact measures of the absorption of light by such great lenses would be of much interest. We may, however, probably assume with some confidence, that if α^2 Centauri were removed to twelve hundred times its present distance it would not be visible in the Lick telescope, even though there were no absorption of light in space; and α^2 Centauri is probably larger and brighter than our sun. (Assuming, with Mr. Gore, a period of 77 years for this binary, and a parallax of .75 of a second, the sum of the masses of the components will be 2.14 times the mass of the sun.)

Stars smaller than our sun would be lost to sight at smaller distances. Consequently the Milky Way must either be nearer to us than a thousand times the distance of

¹ A. C. Ranyard, in Knowledge for August.

α Centauri, or the smallest stars visible in it with a telescope as large as the Washington 26-inch refractor must be larger than our sun, a supposition at which the mind rebels when we remember the vast size this would imply for the larger stars evidently involved in or associated with the Milky Way. For example, in the Pleiades group there are observable with the eye at the telescope a range of some thirteen magnitudes of the photometric scale, which, translated into ordinary language, means that the larger stars of the cluster give more than a hundred and fifty thousand times as much light as the smaller stars of the cluster.

In the photographs of the Pleiades cluster we have evidence of a range of at least fifteen magnitudes, which means that the larger stars give a million times as much light as the smaller stars, and in the photograph of the coal-sack region of the Milky Way there is evidence of a still greater range of magnitudes. The star α Crucis, which is of 1.3 magnitude, is evidently associated with a dense cluster of small stars, branches from which can be traced far across the coal-sack region, and extending to a considerable distance over the Milky Way or into the Milky Way to the north of α Crucis. We seem to have in this instance evidence of a range of at least seventeen magnitudes. α Crucis is a double star with components about five seconds apart, and there are several small companions that have been observed in the telescope. In the glass photograph by Mr. Russell the spurious disk of the large star is, when examined with a magnifier, seen to contain several small stars forming a cluster about the large one. Indeed, some seven or eight of these small stars may be recognized with a magnifying-glass on the edge of the spurious disc of the large star.

Though the mind may at first be staggered by the conception of stars giving a million times as much light as our sun, we are not in a position to deny the existence of such vast sun-like bodies. Indeed those who accept the nebular hypothesis as giving the most probable explanation of the origin, or rather of the birth, of the planets of the solar system, must be prepared to believe that there was a time when the sun had a diameter as large, or nearly as large, as the diameter of the orbit of Neptune. If before these more than geologic ages of radiation into space the surface or photosphere of the solar mass did not shine as brightly as it shines now, it must, at least, have been a nebula with a very definite surface, which, as seen from a distance a hundred times as great as that of α Centauri would have presented a disc nearly half a second in diameter. No disc has at present been observed to any star; we may therefore feel some confidence that there is no such vast sun-like body within a distance from us equal to fifty times the distance of α Centauri.

In the forthcoming part of the "Old and New Astronomy," I have shown reason to believe that there is evidence of absorption of light in space, and that we can, from the numbers of the stars of the various magnitudes, make a rough minimum estimate as to the amount of absorption of light in space, due either to a want of perfect elasticity in the light-transmitting ether, or to dark bodies cutting out or obliterating the light in its passage through space. This greatly reduces our idea of the magnitude of the region we can explore with the telescope and with the camera, — α Centauri would probably be lost to the Lick telescope if it were removed to three hundred times its present distance, — and it also greatly reduces our idea of the distance of the small stars of the Milky Way, and of the scale of the galactic system as well as of the nebular system and of the system

of clusters, red stars, and bright line stars which are so evidently associated with it.

It is not so very long ago that it was generally taught that the nebulae were galaxies of stars more or less similar to the Milky Way that surrounds us, but so inconceivably remote as to appear when observed with the largest telescopes like small spots in the heavens. This theory suited the popular taste, and died hard. It involved the assumption that man could explore with the instruments at his disposal a space so immense that the interstellar spaces which we can just measure or guess at, are dwarfed into points beside the distance from which light travels to us.

The theory should have been disposed of by the observations of Sir William Herschel, who noted that many nebulae are evidently associated with stars, and observed that the smaller nebulae were distributed over the heavens in a manner which shows an intimate connection between them and the brighter stars. He noted that the nebulae in the northern heavens were clustered in the pole of the Milky Way, and descended like a canopy on all sides, leaving a dark space or channel separating the nebulous region from the rich stellar region of the Milky Way. Sir William Herschel also fully satisfied himself that "there were nebulosities which are not of a starry nature," and from his observations of diffused nebulae he formed his well-known hypothesis of a diffused luminous fluid which, by its eventual aggregation, produced stars. But he did not proceed to the legitimate deduction from his observations as to the general distribution of nebulae, viz., that nebulae which are arranged so symmetrically with respect to the stars must belong to the stellar system, and therefore cannot be assumed to lie at immense distances compared with the distance of the Milky Way stars.

Sir John Herschel extended the observations of his father to the southern heavens, and showed that there was a similar clustering of the smaller nebulae on the southern side of the Milky Way, and a similar intimate connection between the distribution of stars and the distribution of nebulae in the southern hemisphere (Cape Observations, p. 134); but it was not until 1858 that the obvious conclusion from these observations was drawn by Mr. Herbert Spencer in a remarkable paper on "The Nebular Hypothesis," published in the *Westminster Review*. He remarked, "If there were but one nebula, it would be a curious coincidence were this one nebula so placed in the distant regions of space as to agree in direction with a starless spot in our own sidereal system. If there were but two nebulae, and both were so placed, the coincidence would be excessively strange; what then shall we say on finding that there are thousands of nebulae so placed? Shall we believe that in thousands of cases these far-removed galaxies happen to agree in their visible positions with the thin places in our own galaxy? Such a belief is impossible."

Mr. Herbert Spencer's paper was not illustrated by charts, and the force of his reasoning was not generally perceived till some ten years afterwards, when Professor Cleveland Abbe drew attention in the *Monthly Notices of the Royal Astronomical Society* for May, 1867, to the intimate connection between the distribution of nebulae in space and stars; and Mr. Proctor, in 1869, constructed some charts on an equi-surface projection, which graphically put his readers in possession of the facts and carried conviction to all who read his remarks.

The theory that the nebulae were distinct galaxies involved the assumption that light can reach us from regions many

thousand times more remote than the stream of stars which compose our own galaxy; and it also involved the assumption that the matter of the universe is aggregated into clusters, separated by immense barren spaces, in which we must assume that there are very few luminous stars, and but few dark stars which would absorb light, as well as comparatively very little opaque matter distributed as meteors are distributed in the region of space we are familiar with.

We have evidence that the greater part of the lucid stars belong to the galactic system, but the large proper motion of some stars, taken in conjunction with their small parallax, affords evidence, as Professor Simon Newcomb has pointed out, that they will in time pass away from our galaxy. (Professor Newcomb has shown in his "Popular Astronomy" that, making the most liberal assumptions as to the number and masses of the stars of our galactic system, the highest speed which a body could attain if it fell from an infinite distance through such a stellar system would be twenty-five miles a second, a velocity which is certainly smaller than that of many stars.) The regions outside our galaxy cannot, therefore, be absolutely barren, but however sparsely luminous stars are distributed through space, if there were no absorption of light in its passage through the ether, and no opaque bodies to blot out the light of distant stars, it would be impossible, as Olbers long ago pointed out, to draw a line in any direction which would not in an infinite universe pass through some luminous star, and the whole heavens ought to shine with the average brightness of such stars.

That the heavens are comparatively dark may, therefore, be taken as proof either that the light-transmitting ether is not perfectly elastic, or that there are numerous dark bodies in space that blot out the light which we should otherwise derive from the more distant parts of the universe.

NOTES AND NEWS.

THANKS to new sanitary measures in England, says the *Medical Record*, there has been a diminution of more than thirty per cent in the death-rate from consumption since 1861.

— In a recent number of the *Archives of Surgery*, Mr. Jonathan Hutchinson says that he has for many years been in the habit of forbidding fruit to all patients who suffer from tendency to gout. In every instance in which a total abstainer of long standing has come under his observation for any affection related to gout, he has found on inquiry that the sufferer was a liberal fruit eater. Fruits are, of course, by no means all equally deleterious; cooked fruits, especially if eaten hot with added sugar, are the most injurious, the addition of cane-sugar to grape-sugar adds much to the risk of disagreement. Fruit eaten raw and without the addition of sugar would appear to be comparatively safe. Natural instinct and dietetic tastes have already led the way in this direction; few wine-drinkers take fruit or sweets to any extent, and Mr. Hutchinson suggests as a dietetic law that alcohol and fruit-sugar ought never to be taken together; and he believes that the children of those who in former generations have established a gouty constitution may, though themselves water-drinkers, excite gout by the use of fruit and sugar.

— A statement, by State Geologist Arthur Winslow, of the operations of the Missouri geological survey during the month of July shows that work on iron ores was begun during the latter part of the month, and inspections were made in Callaway and Wayne Counties. Zinc and lead deposits have been examined and reported upon in Newton, McDonald, Barry, and Lawrence Counties. The occurrence and distribution of coal have been studied in Carroll, Chariton, Howard, Monroe, Buchanan, Nodaway, Gentry, and Davis Counties. Detailed mapping has been prosecuted in Macon, Madison, Ste. Francois, and Ste. Genevieve Counties, and

about 160 square miles have been covered. In the laboratory the analysis of some twenty-two samples of mineral waters have been completed. The work on paleontology and general stratigraphy has been actively prosecuted in the north-eastern part of the State along and adjacent to the Missouri River. The quaternary formations in Buchanan, Jackson, Saline, and adjacent counties have received special study. A work recently started, looking towards obtaining an estimate of the total amount and value of the mineral products of the State up to the present date, has been given special attention during the past month, and is now well advanced. In the office, Bulletin No. 5 will be ready for distribution soon. It consists of a paper on the age and origin of the crystalline rocks of Missouri and one on the clays and building stones of certain counties tributary to Kansas City. Considerable progress has been made in the preparation of Bulletin No. 6, and in the draughting of maps for publication. The granites and porphyries in Madison County have further been studied and their areas mapped, and the distribution of the geological formations have been outlined in a part of Greene County. Inspections of building stones and of clay deposits have been made in Stone, Jefferson, Ste. Genevieve, Mississippi, Stoddard, Scott, Cape Girardeau, Madison, Iron, Wayne, Butler, Greene, Webster, Phelps, and Crawford Counties. In connection with the various works above referred to, many photographs have been taken illustrating the occurrences of minerals and other geological phenomena in the State, and a large number of specimens have been collected for purposes of study, test, and exhibit.

— A correspondent of the *American Field*, writing from Sidney, O., says: "A friend of mine, a careful observer, recently related an occurrence he witnessed some years ago. While watching fish through clear ice in shallow water, he saw a muskrat moving about on the bottom, apparently feeding. Presently the animal stopped and emitted the air in his lungs, which came up in small bubbles to the under surface of the ice. He then came up, put his nose to the large bubble and rebreathed the air. This may be old, but it was new to me, and may be to others."

— In a paper on the density of weak aqueous solutions of certain sulphates, read before the Royal Society of Canada on May 28, 1890, Professor J. G. MacGregor of Dalhousie College, Halifax, gives the following as the general results of his study of the subject: (1) In addition to magnesium, zinc, and copper sulphates, already known to form weak aqueous solutions having a volume less than their constituent water would have in a free state, aluminum, cadmium (possibly), cobalt, and nickel sulphates are found to exhibit the same peculiarity; (2) the formation of such solutions is not a property of the sulphates generally; (3) neither is it a property of all the metals of any one of the groups into which the metals are divided by chemists; (4) the formation of such solutions does not seem to depend upon the amount of the water of crystallization of a salt.

— From a series of observations on woodpeckers, made in the region of Mount Chocorua, New Hampshire, Mr. Frank Bolles, in a communication to the *Auk* for July, draws the following conclusions: that the yellow-bellied woodpecker is in the habit for successive years of drilling the canoe birch, red maple, red oak, white ash, and probably other trees, for the purpose of taking from them the elaborated sap and in some cases parts of the cambium layer; that the birds consume the sap in large quantities for its own sake and not for the insect matter which such sap may chance occasionally to contain; that the sap attracts many insects of various species, a few of which form a considerable part of the food of this bird, but whose capture does not occupy its time to any thing like the extent to which sap drinking occupies it; that different families of these woodpeckers occupy different "orchards," such families consisting of a male, female, and from one to four or five young birds; that the "orchards" consist of several trees usually only a few rods apart, and that these trees are regularly and constantly visited from sunrise until long after sunset, not only by the woodpeckers themselves, but by numerous parasitical humming-birds, which are sometimes unmolested but probably quite as often repelled; that the forest trees attacked by them generally die, possibly in the second or third year of use;

that the total damage done by them is too insignificant to justify their persecution in well-wooded regions.

—London *Iron* says: "A novelty in boat building is the tiny steamer just completed for the Frankfort Electrical Exhibition by Messrs. Escher, Wyss, & Co. of Zürich, and which made a successful trial trip on the Limmat the other day. It is constructed entirely of aluminum, even to the engines and screw propeller, and is the first vessel that has been built of the light, ductile, silver-white 'metal of the future.' The lilliputian bark is twenty feet long and five feet wide, and is driven by a two horse-power naphtha motor. As this compact style of engine, when, as is usually the case, it is wrought out of iron, is already considered one of the lightest on the market, the further advantage gained in this respect when the motor is constructed of aluminum is obvious."

—That severe mental distress or fright sometimes produces physical disease, and occasionally even death, is an admitted fact, according to the *Lancet*, although the way in which it acts has hitherto been but little studied. In order in some measure to supply the deficiency in our knowledge regarding this matter, Dr. G. Bassi has recently made a number of observations on animals which apparently died in consequence of capture. Birds, moles, and a dog which had succumbed to conditions believed by Dr. Bassi to resemble those known among human beings as acute nostalgia and "a broken heart," were examined post mortem. Generally there was hyperæmia, sometimes associated with capillary hemorrhages of the abdominal organs, more especially of the liver, also fatty and granular degeneration of their elements, and sometimes bile was found in the stomach with or without a catarrhal condition. The clinical symptoms were at first those of excitement, especially in the birds, these being followed by depression and persistent anorexia. The theory suggested by Dr. Bassi is that the nervous disturbance interferes with the due nutrition of the tissues in such a way as to give rise to the formation of toxic substances, — probably ptomaines, — which then set up acute degeneration of the parenchymatous elements similar to that which occurs in consequence of the action of certain poisonous substances, such as phosphorus, or to that met with in some infectious diseases. In support of this view, he points out that Schule has found parenchymatous degeneration in persons dead from acute delirium, and that Zenker found hemorrhages in the pancreas in persons who had died suddenly. He refers also to some well-known facts concerning negroes in a state of slavery, and to the occasional occurrence of jaundice after fright. He hopes that these hints may induce medical officers of prisons and others to study both clinically and anatomically this by no means uninteresting or unimportant subject.

—Additional experiments and observations upon ammonite seem to confirm the first opinions regarding its safety and its power. Direct application of heat or concussion fail to explode it. Atmospheric changes exert no influence upon it whatever. It has been tried in a large number of the most dangerous coal mines in England without igniting the gases which were known to be present at the time. A mixture of coal-gas and coal-dust was not exploded by it, even when no more than two inches of tamping was used. The safety tests have been so thorough and satisfactory that the railroads of the United Kingdom accept ammonite as freight without the usual restrictions placed upon explosives, and it even meets the requirements of Sir George Elliot for perfect security, which is saying a great deal. According to the *Railroad Gazette*, ammonite consists of an intimate mixture of 81½ per cent of ammonium nitrate and 18½ per cent of mono-nitro-naphthalene. The manufacture is extremely simple and practically unattended with danger. Being free from chlorates it is not liable to decomposition or spontaneous combustion. Having no picric acid or chlorinated derivatives of hydro-carbons in its constitution it yields no injurious or corrosive fumes among its products of combustion. It is put up for use in lead-foil cartridges and exploded with a detonator. Tests made in England on July 9 showed that it possesses great strength, a projectile of 29 pounds weight being thrown from a mortar elevated forty-five degrees to a distance of 320 feet from the muzzle by a five-grain charge, as against 289 feet by a

similar charge of No. 1 dynamite, and 136 feet by an equal weight of gunpowder. Notwithstanding this, ammonite has as yet only been proved of value in comparatively soft material. Experiments are in progress, however, to secure if possible a high efficiency with this explosive in hard rock work. While the security claimed for ammonite is highly encouraging it should be remembered that it is commonly "the unexpected that happens." It would seem that ammonite possessed a special virtue in the absolute safety of its separate ingredients, and in the great ease of its manufacture, which would enable it to be made upon the spot where it was needed, by any one having even a meagre knowledge of chemistry, and with a very inexpensive plant.

—The Supreme Council of Hygiene of Austria has been engaged in discussing the advantages of erect as compared with slanting writing, and the official report of Drs. von Reuss and Lorenz points strongly in favor of the former. According to the London *Educational Times*, they point out that the direction of the written characters has a marked influence on the position of the body. In "straight" writing the scholar faces his work, and is spared the twist of the body and neck which is always observable in those who write slantwise, and one common cause of spinal curvature is thus obviated. The erect method is, therefore, expressly recommended for use in schools in preference to the ordinary sloping lines.

—M. Constantin Miculesco has communicated to the Paris Académie des Sciences a note on a new determination of the mechanical equivalent of heat. According to *Engineering*, the method used was in principle the same as that of Joule, viz., the production of heat in a calorimeter by means of friction. In Joule's experiments, however, the total work done was small, and hence a long time was required to obtain a sensible heating of the calorimeter, and various difficult corrections had to be made. To avoid this, M. Miculesco made use of a fairly powerful electro-motor to supply the work which was to be turned into heat. The apparatus consisted of a one horse-power Gramme electro-motor, carried on a frame suspended on knife edges, the shaft of the motor being central with the line of these supports. A calorimeter consisting of two concentric cylinders was mounted on a separate frame, so that the axes of the cylinders coincided with the centre line of the motor shaft. This shaft was coupled, by a flexible connection, to one carrying paddles, which it caused to rotate in the water in the cylinder. Under these circumstances the frame carrying the motor tended to swing on its knife-edges so as to balance the torque on the motor shaft, and by correcting this tendency by carefully adding weights, this torque could be measured with great accuracy. The result obtained was $J=777.7$ foot pounds.

—The United States Coast and Geodetic Survey Office at Washington has received a report from Assistant J. E. McGrath of that service, dated June 20, 1891. Camp Davidson, Upper Yukon River, near eastern boundary of Alaska, in which he states that the health of the party has been excellent, and the work at that station is practically completed; and that as soon as the necessary solar observations for rating the chronometer could be obtained, they would leave for St. Michael's. The trip will be made in open boats, as certain magnetic observations were to be made at Fort Yukon, obliging the party to stop there. Mr. McGrath expects to reach St. Michael's by Aug. 25, and in time to come south on the revenue cutter "Bear." In his report Mr. McGrath states that the astronomical observations have been very much delayed by cloudiness and rain. Meteorological observations have been continuously made three times a day. The average monthly temperature since December shows an increase of a few degrees over the same months of the preceding year. The lowest minimum temperature noted was on Jan. 16, on which date the lowest temperature read was -60.5° F. The Yukon River opened nine days later this year than in 1890. Mr. McGrath speaks in the highest terms of the diligent and faithful conduct of all the members of his party, mentioning by name his assistants Mr. Davis and Dr. Kingsbury. The latter gentleman had at the date of the report left camp for home, carrying with him the duplicate records of the party, it being deemed safer to have them sent ahead of the originals, to avoid possible loss of

both sets. Mail has already been received from Dr. Kingsbury from San Francisco.

—Particulars of the observatory which it is proposed to erect on Mont Blanc at the very summit are given in the *Neue Züricher Zeitung*, from which *Engineering* quotes as follows. The idea originated with M. Janssen, who stayed on the mountain some time last summer for the purpose of making meteorological observations. In conjunction with M. Eiffel, and with the support of M. Bischoffsheim, Prince Roland Bonaparte, and Baron Alfred de Rothschild, he has now elaborated the plan of an observatory to be entirely of iron, and to have a length of eighty-five feet and a breadth of twenty feet. The iron roof is to have a spherical form. The erection of such a building on the highest point of Mont Blanc naturally involves preliminary studies, with which a Zürich engineer experienced in works on high mountains has been charged by M. Eiffel and M. Janssen. In the first place, it is necessary that a firm foundation should be found for the supports of the building on the rock of the mountain. For this purpose a horizontal gallery is to be driven through the ice of the highest glacier until rock is met with, and by means of this gallery the formation and position of the rock buried beneath the ice and snow are to be ascertained and examined. If once this has been accurately determined, a structure is to be designed which will give to the observatory a firm hold by iron pillars founded in the rock. The question of how the heavy materials are to be moved to the top of the mountain does not appear to give much concern, but more is thought of the work of surveying, which was to have been commenced this month. Should the surveys prove the practicability of the plan, it is intended to proceed with the erection in September.

—In connection with an item from *Nature* on copepoda in these columns last week, the following communication to the same paper, from Mr. I. C. Thompson of Liverpool will be of interest: "Professor Herdman's practical demonstration at the North Cape confirms a theory I have long held, that the copepoda, which abound in every ocean, sea, and lake, might be largely and advantageously made available for human food. It is well known that the species *Calanus finmarchicus*, so abundant in our northern seas, forms the chief food of the Greenland whale. Our own immediate coasts abound in this and other equally edible species. During a recent dredging cruise round the Isle of Man, each pull of the tow-net contained thousands of another and larger species of copepod, *Anomolocera patersonii*; and Dr. John Murray has found that a still larger species, *Euchaeta norvegica*, is plentiful in the lower depths of several Scotch lochs. A number of finely-meshed trawls, used off the west coast of Ireland, would, I am convinced, furnish excellent food for starving multitudes in time of need. *A propos* of the distribution of copepoda, my attention was called a few days ago by the Mayor of Bootle to the filter-beds of the town salt-water baths, which he said were swarming with *Entomostraca*. The water is supplied direct from the river, and examination showed the presence of copepoda in enormous quantities, the bulk of them being *Eurytemora hirundo*, a species only once before taken in Britain, and then in near proximity to Bootle. Probably other filter-beds are equally prolific, and may prove valuable hunting-grounds, the copepoda undoubtedly acting as scavengers in keeping the water pure from putrefaction."

—It seems as if the introduction of large engineering views may soon produce a very marked effect upon the future of Egypt. Mr. Willcocks, one of the Inspectors of Irrigation, has communicated a letter to the *London Times*, in which he says that the summer supply of the Nile is lamentably deficient for the existing cotton and sugar-cane crops of Egypt, so that all extensions of these valuable crops are out of the question under existing conditions. The Nile Valley in Nubia is eminently suited for storage of water, but up to the present all projects for storing the muddy flood waters of the Nile below the junctions of the Blue Nile and the Atbara have been condemned, as the construction of solid dams would have resulted in the silting up of the reservoirs themselves. This difficulty has disappeared now that it has been discovered that open dams can be constructed that will allow the muddy flood waters to flow through, and store the clear winter

supply for use in summer. The construction of these dams has been rendered possible by the great success of Stoney's patent roller-gates, which can be worked under heads of 70 feet of water on a scale sufficient to pass the full flood supply of the Nile. At any time now Egypt can construct a reservoir in its own territory by building an open dam at the head of the Assouan cataract. If, however, Egypt were allowed to occupy the Nile Valley as far as Dongola, the reach of the river above the Wady Halfa cataract would provide the necessary reservoir, and the Philæ immersion difficulty would be at an end. So far the summer supply needed for Egypt proper. If the Soudan itself is to be developed, it will only be necessary to construct solid dams at the heads of the Ripon Falls and Fola Rapids, and thus secure the Victoria and Albert Nyanza Lakes as magnificent reservoirs. These reservoirs would not only secure Egypt and the Soudan from drought, but would also, if provided with open dams, secure Egypt from excessive floods. The White Nile as it leaves the two lakes is a clear stream, so that the silting up of the reservoir would be out of the question, leaving alone their great size.

—The success of the University Extension scheme in this country, says the *London Educational Times*, has attracted much attention in educational circles in France, and the ministry of education has decided to have the subject investigated on the spot. Accordingly, M. de Varigny, a member of the University of Paris, has been delegated to study the working of the scheme during the present summer and autumn in England and Scotland, and to make a report upon it.

—Professor Langley, the director of the Smithsonian Institution, is now in England. *A propos* of his recent researches on mechanical flight, *Nature* learns that Mr. Maxim is building a "flying machine," with which a series of experiments is contemplated. It is now being constructed at Crayford, and is nearly ready for launching. It will be propelled by a light screw making twenty-five hundred revolutions a minute. The motive power (it is reported) is supplied by a petroleum condensing engine weighing eighteen hundred pounds, and capable of raising a forty thousand pound load. The real suspending power will lie in an enormous kite measuring one hundred and ten feet long and forty feet wide.

—Mr. Edward Stanford has published a pamphlet on "The Spread of Influenza: its Supposed Relations to Atmospheric Conditions," by the Hon. R. Russell. The following, says *Nature*, are some of the author's conclusions as to the conditions which give rise to influenza, and permit it to be spread. Influenza is a disease caused by exceedingly minute microbes, arising from extensive areas of marsh or sodden land in Central Asia, China, or Siberia. The minuteness of the microbes or their spores is shown by their easy transmissibility, and the large number of persons capable of being infected by a single case in a large room, most persons probably requiring many virulent organisms to be inhaled in a short time before the resistant power of the blood is overcome. This microbe, like that of cholera, multiplies with great rapidity, and probably soon produces sufficient poison to terminate its career in the body, but not before multitudes of spores or microbes have been given off by the breath. Given the original conditions of rainfall, soil, and high temperature, the certain result is the development of inconceivable multitudes of microbes and spores. One species of these is capable of planting itself and living in the tissue and blood of man, of which the temperature is probably near that to which it has been accustomed under the summer sun in wet and drying ground. The somewhat rare and occasional visitations of influenza may be due to at least two or three causes—first, the occurrence of unusual rainfall and favorable summers; second, the prevalence of air-currents from the drying area towards inhabited places; third, adequate communication between these infected places and the towns of Russia, whence progress is rapid towards western Europe. The wind has no influence that can be verified in the transportation of influenza. As for the means of prevention, Mr. Russell thinks that measures of disinfection and isolation of the earliest cases, and rules at ports and landing places similar to those employed against cholera, would probably prove of the greatest service. Inland, every locality should isolate and disinfect its first cases.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada.....\$3.50 a year.

Great Britain and Europe..... 4.50 a year.

Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and one hundred copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

JUGGLERY.¹

RECENTLY I met with a certain observation the source of which, to my regret, I failed to note. I therefore take the opportunity of appealing to my readers for their kind help in identifying the passage or quotation in question, because it has a scientific bearing of a very obvious nature. The observation was as follows: A writer, in speaking of the fallacies of the senses, described the Hindoo juggler's trick of causing a small plant to grow out of a flower-pot in which, a few moments before, the conjurer had placed some seeds. The pot is covered over or concealed by a blanket, and when the covering is withdrawn the apparently marvellous and instantaneous growth of the seed into a perfect plant is witnessed. Now, the writer in question goes on to state that an amateur photographer had taken a "snap-shot" at the conjurer and his performance, and when the negative was developed no plant could be seen growing in the pot at all. The inference is that the spectators only fancied they saw a plant, and that the success of the trick is due to the juggler making his audience believe they see what does not really exist. In plain language, he is supposed to hypnotize the spectators, and the illusion is to be regarded not as due to his dexterity but to his power of making the spectators believe they see what he wishes them to behold.

Assuming the incident with the camera to be true and of good report, how is the omission of the flower in the pot to be accounted for? If a photograph of the scene had been taken at all, it must necessarily have included all the details within range of the lens, and, as Boucicault makes one of his characters in "The Octoroon" say, "The apparatus doesn't lie." I do not pretend to criticise the statement at all. I am merely anxious to know if any of my readers interested in psychical matters can confer a favor by referring me to the original source of the story. My own recollection is that I casually met with the reference in an

American magazine, which I glanced at while waiting for a friend. The name of the magazine and its date (which must be recent, I fancy) have both escaped my recollection.

After thinking over the above incident, one is inclined to be somewhat sceptical of the story as I have related it—although my version, I admit, may not be absolutely correct. A perusal of a paper by Chevalier Hermann, the conjurer, confirms me in my scepticism. He tells us that when he visited India he could find no foundation in actual fact for the marvellous stories of Hindoo jugglery, including the fact of "youths tossing balls of twine in the air and climbing up on them out of sight." What Herr Hermann did see in India, he tells us, he could have imitated "with little preparation," and that he "would not presume to introduce them upon the stage." This is a decided blow to the reputation of our Indian friends, and after this assertion the tales of fakirs being buried for six weeks, and recovering thereafter, may reasonably be doubted also, although I shall feel interested in hearing from any of my Indian readers accounts of what they have actually seen in the way of startling magic. It will be interesting if I quote what Hermann has to say of the flower-pot trick, which the unknown psychologist has tried to explain on the basis that the conjurer causes his audience to see what does not exist—a startling enough theory, by the way, since it supposes that all sorts and conditions of men looking on could be simultaneously hypnotized.

In Bombay a troupe of jugglers appeared in front of the hotel in which Herr Hermann was staying. After a short address, an empty flower-pot was produced. This was filled with earth, which was moistened with water, and into the pot a few mango seeds were dropped. A large piece of cloth was used to cover the pot, which rested upon a tripod of bamboo-sticks. Then followed an address to the audience, and the operator walked slowly round the covered pot, "dexterously allowing his robes to envelop it at each turn," while the other members of the troupe chanted a kind of incantation. After some three minutes occupied in this performance, the incantation ceased, the cloth was removed, and in it was seen growing a mango-tree about three feet in height, the plant having apparently grown after the planting of the seed. This is a bare description of what the Western conjurer saw his Eastern rivals perform, and it sounds very wonderful, no doubt. Hermann's explanation of the trick, however, causes us to repeat the hackneyed expression that "it is not at all startling when you know how it's done." What the Hindoo wizard did was to remove the pot from beneath the cloth—a dexterous proceeding enough, but not a whit more wonderful or clever than things we see done at the Egyptian Hall or at other entertainments of like nature—and to substitute the growing mango, which he carried concealed under his robe. "This," adds Hermann, "he did rather clumsily, while he let the robe rest, as if by accident, over the covered flower-pot previously displayed."

This recital is interesting scientifically, because, as I have said, we hear so much about Indian jugglery and esoteric mysteries, which no science is supposed to be capable of explaining, that one may find some justification for a continued display of scepticism when still more mysterious feats are gravely detailed. I find that the facts about Indian magic and mystery set forth in books in grave, circumstantial array do not always coincide with what actually occurs; hence my appeal to Indian readers of these lines for accounts of things they may have seen in the way of live burials and resuscitations (if such things are still in vogue) and like phenomena.

¹ Dr. Andrew Wilson, in the *Illustrated News of the World*.

I referred, when I began these jottings, to the idea that the explanation of a trick was to be found in the delusion of the spectator's senses; and this reminds me of a very interesting case which certainly proves to us how a dominant idea may be impressed on the minds not of a few spectators but of thousands, with an utterly futile result when all is said and done. When the Crystal Palace took fire, many years ago, efforts were made to rescue the animals from the menagerie, which was lodged in the burning part. As the fire progressed, a large monkey was seen by the spectators to appear on the roof and to hold on to some pinnacle or other, apparently writhing in terror at its impending incineration. Desperate attempts to reach the unfortunate animal were made. The crowd was breathless with anxiety. Every movement of the rescuers was watched with agonizing interest. At last the ape was reached, and was found to be—a piece of canvas, which had apparently been detached from the building, and which, clinging to some post or pole, had impressed the crowd, by its flapping, with the idea that it was a big monkey writhing with fear and agony. This, I believe, is a well-founded fact. It proves to the full, of course, that, given an idea, supported by a fair show of demonstration, such a thought is certain to become dominant and overruling in the minds of many men. How far this principle may serve to explain many another delusion of human life, I leave my readers to judge.

LECTURE EXPERIMENTS ILLUSTRATING PROPERTIES OF SALINE SOLUTIONS.¹

(1) In a paper printed in the last volume of this institute's proceedings (Proc. N. S. Inst. Nat. Sci., vii., 363) I pointed out that, according to Kohlrausch's observations, sufficiently dilute solutions of sodium hydroxide have volumes which are less than the volumes which their solvent water would have in the free state, one gram of a solution containing about six per cent of the hydroxide, having a volume 0.0045 of a cubic centimetre less than the water contains. Several other substances are known which exhibit the phenomenon of contraction on solution, in a similarly marked manner, but none which exhibit it to such an extent. This hydroxide, therefore, affords the best means of exhibiting the phenomenon of contraction by a lecture experiment.

The simplest mode of conducting the experiment is to pass the powdered caustic soda, little by little, down a glass tube forming a prolongation of the neck of a large bottle, the bottle and part of the tube having been first filled with distilled (or, indeed, undistilled) water. The substance is quickly dissolved by the water, the strong solution thus formed sinks and mixes with the water below, and the change of volume of the liquid is indicated by the change of height of the column of liquid in the tube. In order that the experiment may be made quickly, the powder must not be allowed to form a cake in the tube where it meets the water. To avoid this, a tube of about seven or eight millimetres in diameter must be used. It should be seven inches in length, and should have the upper end opened out to a funnel shape, to facilitate the introduction of the powder. The tube being necessarily of large bore, the bottle must also be large, so that a small change of volume may be indicated by a comparatively large elevation or depression in the tube.

The hydroxide should be in the form of a powder, not only that its solution may be accomplished quickly, but also because the solution formed must be dilute in order to secure a depression of the liquid in the tube. If it be not powdered, the substance falls to the bottom and forms a strong solution there, which only gradually diffuses into the water above. Even with a fine powder, however, a comparatively strong solution is formed at the bottom. Hence I have found it advisable to catch the powder in a wire gauze cage, attached by sealing-wax to the inner end of the rubber

stopper which carries the tube, and to hasten the mixture of the strong solution, formed in the tube and cage, with the water, by diverting the downward currents of the strong solution towards the sides of the bottle by means of a plate of glass hanging horizontally below the cage. If a wide-mouthed bottle be used, a stirrer may be introduced through the stopper, but leakage is thereby rendered more probable.

The full amount of the contraction indicated by Kohlrausch's observations cannot, of course, be shown. For (a) the powdered caustic soda already contains a considerable quantity of water; (b) the solution of the substance is attended by a development of heat involving a rise of the liquid in the tube; (c) the powder carries air with it into the water, which must increase the volume whether it dissolves or remains suspended, for in the latter case, if a quick effect is desired, there is not sufficient time for it to escape up the tube; and (d) whatever precautions may be taken to secure a uniform solution throughout the bottle, it cannot be at all completely secured in the time at disposal. But notwithstanding these difficulties, the experiment is a very striking one, especially if projected by a lantern on a screen. As the powdered caustic soda is passed down the tube, little by little, the liquid is seen to dissolve it without any increase in bulk, and if the substance does not already contain too much water, with an actual diminution in bulk, the level of the liquid sinking in the tube. If the powder be added in large quantity, there is a sudden rise of liquid in the tube, followed by a gradual shrinkage, which continues until the level of the liquid is lower than at the outset. The amount of the depression of the liquid in the tube is sometimes small, depending apparently upon the amount of water which the powdered caustic soda has already absorbed. The substance should not be too finely powdered, as in that case it is likely both to have taken up a considerable quantity of water and to carry down with it a considerable quantity of air. The experiment requires only a few minutes to perform.

(2) The working hypothesis which I use when thinking of the phenomena of solution, has led me to the conclusion that elevation of the temperature of a solution will have, if not identically, at any rate in a general way, the same effect on its selective absorption of light, and therefore on its color, as increase in its concentration. All the experimental evidence of which I can find any record bears out this conclusion. But, whether it holds generally or not, it may be shown, by a striking lecture experiment, to hold in the case of two salts, the chlorides of cobalt (CoCl_2) and of iron (FeCl_3). To do so, make a trough, for projection with a lantern, having thin glass sides, about the size of a lantern-slide, the glass sides being one or two millimetres from one another. It may readily be made by cutting a U-shaped piece from a sheet of India-rubber, and cementing the glass plates to its opposite sides. Half fill the trough with a saturated solution of either salt, and fill up with a weak solution. If cobalt chloride have been used, the solution in the lower part of the trough will at ordinary temperatures be of a purplish blue, that in the upper part red; and it will be obvious that increase of the concentration of this salt involves increase of blueness in the transmitted light. If, now, a Bunsen flame be played carefully over one side of the trough, the solutions rapidly rise in temperature, and both are seen to increase in blueness, the saturated solution becoming deep blue and the weak solution purplish red. If the iron chloride have been used, the solution in the lower part of the trough, before heating, is seen to be of a deep orange color, that in the upper part yellow; and it is obvious that increase in the concentration of this salt involves increase in redness. If, now, the flame be applied as before, the yellow solution is at once seen to become orange and the orange solution red. Owing to the narrowness of the trough and the thinness of its glass sides, sufficient heating to produce a marked change of color occupies only half a minute or so. The same trough may of course be used to project the absorption spectra of these solutions on the screen. If the slit be covered half by the one solution and half by the other, both absorption spectra may be seen at once, side by side, and the gradual variation of the spectra may be watched as the trough is gradually heated.

As a means of showing the variation of the color or absorption

¹ Professor J. G. MacGregor, in Transactions of Nova Scotian Institute of Science, session of 1890-91.

spectrum of a solution with concentration, the above experiment has an obvious defect, viz., that the thickness of the layer of the strong and weak solutions being equal, the numbers of the salt molecules through which any ray of light passes are very different in the two cases. It should therefore be supplemented by showing also the color or the spectrum obtained when the light is passed through a wide trough of the dilute solution, the ratio of the widths of the troughs being the reciprocal of the ratio of the percentages of salt in the two solutions.

(3) Dr. W. W. J. Nichol's observation (Phil. Mag., Ser. 5, xix., 453) that anhydrous sodium sulphate will dissolve in a supersaturated solution of that salt may readily be shown as a lecture experiment by projection. For that purpose place a test tube containing the solution in a trough with glass sides full of water, and focus it on the screen. Then let the anhydrous salt in the form of a fine powder, fall upon the surface of the solution. By taking a pinch of the powder between the thumb and forefinger (both being quite dry), it may be made to fall as a shower of fine particles. These pass into the solution and are seen to move slowly across the screen through the solution, dissolving as they go, in some cases disappearing, and often changing the concentration of the part of the solution through which they have passed, so as to produce obvious refraction effects. Finally, to show that the solution was supersaturated, add a few crystals of the hydrated salt and crystallization at once occurs. The anhydrous salt must be added as a shower of fine powder, as larger pieces may — by taking up water and forming crystals of the hydrated salt before they can dissolve it — give rise to a general crystallization of the solution.

(4) The peculiarity of the solubility in water of such substances as aniline, carbolic acid, etc., observed by Alexejew (Wied. Ann. Bd. XXVIII., 305), may readily be shown on the screen, by using carbolic acid, whose critical temperature (the temperature above which it and water are mutually infinitely soluble) is about 69° C. For this purpose, pour some of the acid into a long test-tube, of about twelve or fifteen millimetres in diameter, and add water. The water will lie in a layer above the acid. Support the test-tube by a clip grasping at the top, and focus on the screen. The line of demarcation between the two liquids will be evident. Now mix the liquids by stirring, and the whole becomes cloudy. Let the tube stand, and the liquid separates again into two layers, having different depths from those they had before, both being now solutions. As this process requires considerable time, the stirring may have been done beforehand. Next surround the test-tube by a beaker of boiling water, passing it upwards from below, and stir the liquids with a hot glass rod. A slight cloudiness appears, but the liquid quickly clears and is seen to have become homogeneous throughout, the line of demarcation having disappeared. If now the beaker of hot water be removed, and one of cold water be substituted for it, the liquid becomes cloudy, a strong solution separating out everywhere, and the little spherical masses of strong solution sinking and coalescing as they sink, to form larger spheres. After a time the liquid is seen to have again become separated into two layers. If the necessary time is not available, the separation into layers may be obtained very quickly by removing the beaker of cold water and again applying the hot bath, which, raising the temperature, stops the separating out of the strong solution and re-dissolves it in the surrounding weaker solution, thus producing a comparatively strong solution in the lower part of the tube and a comparatively weak one in the upper part. The experiment requires but a few minutes and is both striking and instructive.

SOME DISEASES OF LETTUCE AND CUCUMBERS.

DURING the past winter and spring James Ellis Humphrey, professor of vegetable physiology at the Massachusetts Agricultural Experiment Station, has been engaged in the study of certain diseases of lettuce and of cucumbers, cultivated under glass. The investigation of some of these is sufficiently advanced to justify the following preliminary announcement, given in Bulletin No. 40 of the station mentioned.

The rotting of lettuce has been a source of much loss to gar-

deners who cultivate that plant as a winter crop, but its cause, and, therefore, proper preventive measures, have not been known. It usually appears first just above the surface of the soil at the attachment of the lower leaves to the stem, and then spreads to the centre of the head, causing the stem and the bases of the lower leaves, and later the whole of the tender inner leaves, to become decomposed into a slimy mass. The larger leaves being thus cut off from the stem by decay at their bases usually dry up; and there appears after a time, on the remains of the plant, if left undisturbed, the erect, spore-bearing threads of one of the imperfect fungus forms known by the name *Botrytis* or *Polyactis*. The vegetative threads of this fungus are to be found in the decaying tissues of the host in the early stages of the trouble, and no other fungus has ever been observed in connection with it. The professor's observations make it practically certain that the disease is due to the fungus-form mentioned, and this view is supported by the fact that similar forms are known to produce similar diseases in some other plants. This fungus appears to be able to develop also a saprophyte on old lettuce-leaves and other vegetable refuse, and may thus survive a long interval between two crops of lettuce, resuming its parasitic habits when the opportunity is afforded.

From what has been said, it is evident that careful and thorough treatment is essential to the control of the disease in question; and the nature of the crop limits this treatment to the removal of all sources of infection. All affected lettuce plants should be at once removed wholly from the house and destroyed by burning. For this purpose the boiler furnace is conveniently at hand. All dead leaves or other refuse should be often scrupulously cleaned up and burned, so that no breeding places may be left for the fungus. A house which has been very badly infested by the disease should be thoroughly cleaned, whitewashed, or painted, and supplied with fresh soil before a new season's operations are begun; and one may then expect, with the observance of the above described hygienic precautions, to be able to enjoy comparative freedom from loss from this cause.

The powdery mildew of the cucumber is due to the presence of a fungus which has been long known, but which has not been heretofore reported as occurring in America, so far as can be learned. It has been received during the past season, on leaves of greenhouse cucumbers, from Dr. Jabez Fisher of Fitchburg and from Professor L. H. Bailey of Cornell University. The fungus, as has been said, attacks the leaves, on whose upper surfaces it forms at first rounded spots, which appear like blotches of a white powder. These spots gradually enlarge and become confluent until the leaf is practically covered. Those parts of the leaf which are attacked soon turn yellow, and finally become dead and dry. Under favorable conditions the disease spreads quite rapidly and is very destructive.

The fungus which causes the trouble is known as *Oidium erysipthoides* Fries, var. *Cucurbitarum*, and is the conidial or summer spore stage of one of the fungi known as "powdery mildews." It is impossible to say certainly to which of the perfect or winter spore forms of the group it belongs.

It has been found by Professor Bailey and by Dr. Fisher that the fungus may be kept in check by frequent spraying with a solution of sulphide of potassium (liver of sulphur) in water. The proportion usually given is one ounce of the sulphide to two gallons of water, but both Dr. Fisher and Professor Humphrey have found this solution injurious to the foliage and the young cucumbers. A preparation containing an ounce to three gallons is certainly strong enough, and one with an ounce to four gallons is probably so.

As recommended for the lettuce disease, a house in which this fungus has been troublesome should be thoroughly cleaned and fumigated before the next season's crop is started.

THE AGRICULTURAL PRODUCTS OF MADAGASCAR.

M. D'ANTHOUD, Chancellor of the French Residency at Antananarivo, has recently made to the French Government an interesting report upon the economic condition of Madagascar, a translation of which appears in the *Journal* of the Society of Arts

for July 31. In that portion of the report which is devoted to the consideration of the agricultural development of the island, it is stated that the chief agricultural products are sugar, coffee, cocoa, vanilla, cloves, rice, potatoes, tamarinds, indigo, wine, oranges, and lemons. Sugar cultivation was first commenced in 1842; and two factories were erected at Manangary. Good results were obtained in the first two years; but, during the third year, riots took place among the workmen, and the plantations were destroyed. In 1878 three new factories were established in the neighborhood of Tamatave; and in 1883, on the outbreak of hostilities between France and Madagascar, they were in full working. At the present time, the number of plantations round Tamatave has greatly increased; and also in the south, towards Mahanoro and Vatomandry. The expenses of cultivating are greater near Tamatave, by reason of the high price of land and the scarcity of labor, than in the south, towards Vatomandry and Manangary, where labor and land are cheap. Leases are usually granted for twenty-five years, renewable at option. They may even be granted for a period of ninety-nine years.

Coffee trees grow well in Madagascar; and it is stated to be by no means an uncommon thing to see plantations that are forty-five years old, and even more, which have never ceased to yield good results. European travellers, it is said, are frequently struck by the healthy appearance and the quantity of berries in most of the plantations made round the houses or in the villages inhabited by the natives, even when these plantations appear to be abandoned and left to take care of themselves. A large plantation has recently been established in Imerina by a French company; it extends over an area of about 800 acres. Great results are expected from the development of the coffee industry in Madagascar, as the difference between the cost price and the price it realizes in European markets allows of a considerable outlay on its cultivation and then leaves a large margin of profit.

The cocoa tree was introduced into Madagascar by means of seeds brought from the Mauritius and Reunion, in which places it has been for a long time a source of considerable revenue. The tree commences to bear at the end of three years, but it is only in full bearing at the end of the fifth year, and it so remains for thirty years. The cost of cultivation is less than that of coffee. The cocoa tree is chiefly cultivated in the eastern portion of the island, and it is only of recent years that the industry has assumed any importance. In 1883 there were not less than five or six thousand trees round the coast, and these were abandoned when the war broke out. After the war it was found that, notwithstanding the want of care and attention, the young cocoa plantations were still flourishing, and this phenomenon encouraged the planters to pay greater attention to the development of this cultivation. This development dates from the year 1888. Like cocoa, vanilla is one of the agricultural products which has a great future before it in Madagascar, and its cultivation is largely engaged in in Vatomandry, Mahanoro, and Mahela. Vanilla plants commence to yield after the third year, and in the fourth they are in full bearing.

The cultivation of rice, which is well-developed in the interior of the island, is very much less so on the coasts, where the land is more fertile. While in the latter districts the inhabitants are content to sow the seed without any preparation of the ground but the burning of the trees and grass, the Hovas and the Betsileos, having a much poorer soil, take more pains to develop and perfect their system of cultivation. In some instances, for example, in the neighborhood of Antananarivo, they have transformed immense tracts of marsh land into rice plantations. The plains of Betsimitatatra, towards the west of the capital, which are watered by the Ikopa, Andromba, and Sisaony rivers, now the centre of the rice production in Imerina, have been drained and cleared, irrigating canals have been pierced, and everything has been done to favor the production. Similar well cultivated plains are found in great number in the south of Imerina and in Betsileo. In the mountain districts the rice grounds are laid out in terraces on the slopes of the mountains and hills, and rice grounds are frequently met with rising tier upon tier up to the very summit of the high mountains.

The following is the method of cultivation employed by the

Hovas and Betsileos. The rice is first of all sown, then, when it has attained a height of fifteen centimetres, it is plucked up and replanted. The preparation of the ground is an operation to which considerable attention is devoted; it is first of all heavily manured, and when the seed is sown and commences to shoot up, it is subjected alternately to the action of the sun and moisture. In the transplanting, the same system is followed as in other rice-growing countries, care being taken to choose a wet season of the year. The ground must, first of all, have been subjected to various treatments, which would have the effect of transforming it into a kind of mud. In many districts this is effected by trampling over the inundated lands, already softened by driving herds of oxen over them. An improvement in the methods of cultivation practised by the natives of the coast, and of the means of transport, would, it is said, give to this industry its old importance. As regards the future of rice cultivation in the interior, it would never rise beyond the needs of local consumption, as it would be impossible for a low-priced product such as this to bear the heavy expenses of transport by land. Its cultivation, however, would prove remunerative to farmers and others if they would establish factories for the distillation of the alcohol obtained from the rice. At the present time, in the interior of the island, a tenth part of the rice lands only are cultivated, and this suffices for the requirements of home consumption.

Potatoes are largely cultivated in the districts round Ankaratra, and considerable quantities are placed upon the neighboring markets and at Antananarivo, principally for the consumption of the natives. Tamarinds are common all over the west coast, where the plants form immense thickets. The Sakalaves distil spirits from the fruit. Peaches grow almost wild all over the island, and the same may be said of the indigo plant.

As regards vines, there are different species in Madagascar. One variety was originally imported from Portugal; another variety appears to be indigenous to the soil. In Imerina attempts have been made in recent years to acclimatize vines, but some which were brought from Bordeaux have not succeeded. On the other hand, American vines have prospered, but the grapes are not of a superior kind, and the wine made from them is very poor. Orange and lemon trees are found all over the island, growing in a wild state on the coasts, and cultivated in the interior.

As regards textiles, ramie, flax, cotton, and hemp are grown. Plantations of the former were made at Vatomandry, in 1882, which have since increased. The want, however, of decorticating machines has caused this cultivation to be abandoned. Hemp is cultivated in Imerina and Betsileo. Cotton was formerly an important cultivation in Madagascar. The natives gathered it, and themselves manufactured the fabrics, which served them for clothing. Since the importation, however, of American and English cottons, the local industry has been almost killed. M. d'Anthouard says that in view of the fact that cotton grows so easily and quickly in Madagascar, more particularly in the territories bordering on the west coast, where it may be found almost in a wild state, it seems extraordinary that no one, up to the present, has thought of making cotton plantations, either for the export of the raw material, for working it up on the spot, and selling the yarn to the natives, or even for making fabrics which, seeing the heavy expenses of freight and transport which bear upon foreign products, would compete very favorably with similar American goods.

IS THE MARINER'S COMPASS A CHINESE INVENTION?

A WRITER in the *North China Herald* of Shanghai devotes a learned article to detailing and discussing the facts regarding the claim of the Chinese to have invented the mariner's compass. They did not learn the properties of the magnetized needle from any other country. They found it out for themselves, though it is impossible to point to the man by name who first observed that a magnetized needle points north and south. He suggests that it came about in this way. The Chinese have in their country boundless tracts of ironstone, and among these no small portion is magnetic. Every woman needs a needle, and iron early took the

place of the old stone needles, and were commonly used before the time of Ch'in Shih-huang—that is, more than twenty-one centuries ago. Whenever a needle happened to be made of magnetic iron, it might reveal its quality by falling into a cup of water, when it happened to be attached to a splinter of wood, for example. It came in some such way to be known commonly that certain needles had this quality. The great producing centre for magnetic iron is T'szhou, in southern Chihli. This city was very early called the City of Mercy, and the magnetic stone produced there came to be known as the stone of T'szhou, and so *T'szhou* became the ordinary name for a magnet. Later, the Chinese began to speak of the city as the "City of the Magnet," instead of calling it the "City of Mercy." The polarity of the magnetic needle would become known to the Chinese of that city and its neighborhood first. The first who noticed the polarity would be some intelligent person who communicated the fact as an unaccountable peculiarity in an age when omens and portents were diligently sought for in every natural object and phenomenon.

The earliest author who mentions the "south-pointing needle" lived in the fourth century B.C. There can be no reasonable doubt that the polarity of the needle was known at that time. The discovery of the fact must have preceded the invention of any myth embracing it. As to the discovery, there is no reason to suppose it was in any way foreign, because the Chinese use an enormous number of needles, and have an inexhaustible supply of ironstone. But though the polarity was known, it was not turned to a practical use till the Tsin dynasty, when landscapes began to be studied by the professors of *fengshui*, or geomancy. There was at that time a general belief in the magical powers of natural objects. This was a Buddhist doctrine, and it took firm hold on the Chinese mind of that age. The Chinese philosophers of those times taught that indications of good and ill luck are to be seen all through nature. The polarity of the needle would take its place in this category of thought. Though it is not distinctly mentioned by writers of the fourth century, yet to their disciples it became an essential part of the landscape compass which the professors of *fengshui* all use. Kwo Pu, the founder of this system, died A.D. 324, and it was not till four centuries later that the *fengshui* compass began to assume its present form.

The compass used by the professors of geomancy for marking landscape indication was first made about the eighth century. It was of hard wood about a foot wide, and it had in the centre a small well in which a magnetized needle floated on water. On the compass were inscribed several concentric circles, as on the wooden horizon of our globes. They embrace the twelve double hours, the ten denary symbols, eight diagrams, and other marks. This compass was used in preparing a geomantic report of any spot where a house or tomb was to be constructed, so that the construction might not be upon an unlucky site or planned in an unlucky manner. At the same time there was living a Chinese who had studied Hindoo astronomy, and was the imperial astronomer, and also a Buddhist priest. He noticed that the needle did not point exactly north, and that there was a variation of $2^{\circ} 95'$. This variation went on increasing till a century later, that is, till the ninth century. A professor of geomancy then added a new circle to the compass. On this improved compass the first of the twelve hours begins on the new circle at $7\frac{1}{4}^{\circ}$ east of north.

The compass, it will be observed, grew out of the old astrological report or nativity paper, calculated from the position of the stars, and prepared in the Han dynasty by astrologers as a regular part of social life, especially when marriages were about to be solemnized. Some of the old astronomical circles are preserved in the new geomantic chart. This was the compass used when Shen-kwa wrote on the south-pointing needle in the eleventh century. This author mentions that any iron needle acquires polarity by rubbing it on a piece of loadstone. He alludes to the variation as a fact which he himself had observed, and speaks of the south-pointing needle as an implement used by the professors of geomancy. By them it was employed in the form of a float upon water. After this, in 1122, an ambassador to Corea describes the use of the floating needle on board ship while he made the voyage. This is the first instance, the earliest by more than a century, of the use of the mariner's compass on board ship,

found as yet in any book, native or foreign. The existence of the book in which this is recorded settles the question of the first use of the mariner's compass at sea in favor of the Chinese. At that time the needle floated on water supported on a piece of wood, but in the Ming dynasty some Japanese junks engaged in piracy were captured by the Chinese, and the compass in use on board was found to have the needle dry and raised on a pivot, while still pointing southward. The Japanese had learned from the Portuguese navigators to make a compass of this kind, and probably the needles they used were brought from Europe. From this time, the Chinese adopted the principle of a pivot, and made their compasses without a well of water in the middle to float the needle in. Charts were probably used of a very rough kind, but how far is not known. What is known is that the junk-master was aware of the direction in which the needle must point to reach the port to which he was going. In the Sung dynasty, embracing part of the tenth, as well as the eleventh, twelfth, and part of the thirteenth centuries, Chinese junks went to Persia and India. The Arabs trading to China directly would learn at that time the use of the compass, and would apply it on board their dhows. From them the Europeans learned this useful invention.

The credit of the discovery, both of the polarity of a magnetized needle and its suitability for use by mariners at sea, must, therefore, according to the writer, be given to the Chinese, says *Nature*, in commenting on the article. It is China also that has the credit of having first noticed that any iron needle may be polarized by rubbing it with a magnet. In the thirteenth century the Arabs used a floating compass on their dhows. The needle was made to float on the water by attaching it crosswise to a cornstick or splinter of wood. A magnet applied to it drew it into a north and south direction. They would use Western notation to mark the quarters and intermediate points on the horizon. When, therefore, the mariner's compass was adopted from them, the Chinese 24 points were not communicated. In the European compass the notation of 32 points is Western, and rests on the winds and the sun. In the Chinese primitive mariner's compass the notation is that of the professors of geomancy, and rests on the old astrological division of the horizon into twelve double hours. From the Arab account we learn, what the Chinese accounts do not tell us, that the Chinese floated the needle by inserting it in a splinter of wood.

LETTERS TO THE EDITOR.

Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Crime among Washington Negroes.

A CONTRIBUTOR to the Washington *Evening Star* of the 5th instant, signing himself "A Friend of the Negro," has recently been making some comparative studies of the records of the Washington police courts, and greatly deplores the showing for crime they exhibit against the rising generation of Washington negroes. He states, and there is every reason to believe that his statement is true, that "the police report for the year ending June 25, 1890, shows as follows: assaults on policemen, 162, by whites 75, by colored 87; assaults on special officers, 25, by whites 9, by colored 16. Last year three policemen were killed by negroes, two when attempting to arrest them; and there is scarcely a year that this does not occur. In the *Star* of Dec. 24, 1888, it was stated that there were then in jail, awaiting trial or sentence for murder, 16 persons, 3 white and 14 colored. In the *Post* of March 26, 1890, it was stated that there were then on the calendar 18 murder trials, and in the *Star* of Dec. 29, 1888, it was stated that there had been in the District during the year 26 murders, the greater portion of which was by negroes. Now, when it is borne in mind that they constitute but one-third of the population, it will be seen that this is a terrible record."

Investigating this matter still further, the *Star* correspondent is enlightened in other directions, for he soon finds out that it is the present generation of negroes that is responsible for the majority

of these misdemeanors. He finds that it is not only the pseudo-civilized, coal-black Ethiopian, but more frequently the species to which I alluded in *Science* (No. 416) as "the hybrid," that is developing a marvellous fondness for whiskey, who almost invariably goes armed either with a razor or a "bull-dog" revolver, who are the law-breakers, who are rapidly becoming the skilled burglars, and who are far more dangerous than a savage for a lady to meet alone anywhere after dark.

This "Friend of the Negro," mark you, ascertained still more, much of which is quite in tune with the present writer's remarks in the Washington *Anaostan Magazine* of last February, and several other quarters. He adds, "What makes it more disheartening is that here they are in every respect in the full enjoyment of all their legal rights, and in all particulars are on a perfect equality as citizens with the whites. They have the same privileges in the schools, are taught the same branches, have the same school buildings, and there is the same amount per capita spent for them as for the whites. They are abundantly provided with churches and Sunday-schools [*sic*], and, in addition, have the example [*sic*] of some of the ablest and most cultured of their race residing here in our midst." (!)

Now to this particular "Friend of the Negro" I would briefly suggest a study of a few of the higher and a few of the more lowly races of man since the dawn of history. Make those studies comparative. Next, master some of the more practical laws — and there are few or none that are not so — of biologic evolution. Get a good realizing sense of how long it has taken the white race to arrive at its present stage of civilization, and especially the fact that races of men are often quite as far separated mentally, intellectually, and psychologically, as are other races of vertebrates. Induce, if possible, some friend who is informed in such matters to impart a few wholesome facts in the premises. If I am not radically mistaken in the grade of good sense of our "Friend of the Negro," at the end of six months' time he will awaken to the fact that he has before him for study one of the most advanced races in civilization on the face of the globe, the "so-called white," which race is now the victim of another and a *parasitic* race, the "so-called negro," — vicious, low, and barbarous, with a race history, so far as it can be traced, (!) that will not bear investigation. It is not so very long ago since some of them were human flesh-eaters. As an evolutionist, as a zoologist, and as perhaps other things, I can inform the *Star's* contributor that it is quite a useless experiment to place a turkey-vulture in a cage of sky-larks and expect him to sing next morning. Moreover, it is just possible that the experiment may prove a dangerous one for the larks.

DR. R. W. SHUFELDT.

Takoma, D.C., Aug. 10.

BOOK-REVIEWS.

Achievements in Engineering during the Last Half-Century. By L. F. VERNON-HARCOURT. New York, Scribner. 311 p. 8°. \$1.75.

THE author of this work has already made himself known as a writer on engineering topics by his previous books on "Rivers and Canals" and "Harbours and Docks." In this book he describes briefly some of the principal engineering works carried out within the last fifty years, avoiding technical phraseology as far as possible. This will, of course, add to the attractions of the book for the general reader, for whom it is mainly intended; but the attention given to details, and the comparisons made between similar works carried out under different circumstances, give the book a special value for engineers.

There has been no lack of material for the book. In fact, one of the chief difficulties in the preparation of a work of this kind, when undertaken with due regard to "perspective," is the judicious selection of subjects. In this respect, we think, the author has made no mistake. Beginning with railways, he treats first of the London underground and the New York elevated roads; then of those crossing the Alps, the Andes, and the Rocky Mountains; after which a chapter is devoted to narrow-gauge, Fell, Abt, and the Rigi and Pilatus railways.

Two chapters are given to tunnels, one being devoted mainly to

those piercing the Alps, the other treating of river tunnels, such as the Detroit, Hudson, Mersey, Severn, and Sarnia, and the Thames subways. After a chapter on the progress and principles of modern bridge construction, he gives some details concerning the Hawkesbury, St. Louis, Garabit, Hooghly, Brooklyn, Forth, and Tower bridges, with some remarks on the possibility of a bridge across the English Channel. A brief chapter on submarine mining and blasting relates principally to the operations at Hell Gate in the East River.

The engineering works involved in the improvement of the chief sea-ports of the world and of some of the great river channels are very fully described; and ship-canal are by no means neglected, two chapters being given to the Amsterdam, Manchester, and Suez canals, as well as to the work thus far done on the Panama, Corinth, and Nicaragua canals. The latter, by the way, he locates on the Isthmus of Panama, under which name he seems to include all the territory extending from the mainland of South America as far north as the United States.

In the last two chapters of the book the author writes of the Manchester water-works, the Vyrnwy dam and lake, the Eddystone lighthouse, and the Eiffel tower. The book is handsomely illustrated, full-page views being given of many of the subjects treated of, and an excellent portrait of Robert Stephenson making an appropriate frontispiece.

As a whole, the book is one to be commended, though there are points in which it might be improved, as viewed from an American standpoint; and there are occasional evidences of hurried work, as, for instance, the following sentence, which, though conveying much information in small space, would hardly pass muster as a sample of good style: "The elevated railways are owned by two separate companies, and worked by a third company, to whom the lines are leased for 199 years, by means of locomotives, with coupled driving-wheels $3\frac{1}{2}$ feet in diameter, and bogie wheels 2 feet in diameter" (p. 20).

AMONG THE PUBLISHERS.

THE Humboldt Publishing Company have just ready "Mental Suggestion," by Dr. J. Ochorowicz, sometime professor extraordinary of psychology and nature-philosophy in the University of Lemberg. The preface is the work of Charles Richet.

— Longmans, Green, & Co. have just ready "Cookery for the Diabetic," by W. H. and Mrs. Poole, with a preface by Dr. Pavy; and "With Sack and Stock in Alaska," by George Broke, which will interest all who enjoy records of travel in out-of-the-way lands.

— Charles Collins has just published a fourth revised edition, by Professor Sheldon, of Olmsted's "Natural Philosophy;" also Sheldon's "Electricity," being chapters on electricity prepared for and included in the preceding book, but published separately for the use of students in college.

— Macmillan & Co. call attention to the new work of Louis Dyer, late assistant professor in Harvard University, entitled "Studies of the Gods in Greece." Professor Dyer explains the development of the cults of Demeter, of Dionysius, of Æsculapius, of Aphrodite, and of Apollo. The gods are treated with the reverence that is due to them, and the fact is emphasized that there is much in Christianity that is of Greek rather than Jewish quality.

— D. C. Heath & Co., Boston, have just published a "Manual of Plane Geometry," on the Heuristic plan, with numerous extra exercises, both theorems and problems, for advanced work, by G. Irving Hopkins, instructor of mathematics and physics, Manchester High School, N.H., with an introduction by Professor Safford of Williams College. The book is designed primarily for the author's pupils, and secondarily for the constantly increasing number of teachers who are getting more and more dissatisfied with the old methods of teaching geometry.

— G. P. Putnam's Sons have just ready the third part of the "Talleyrand Memoirs." This instalment continues the report of the Congress of Vienna in 1815, the Second Restoration, and the Revolution of 1830. It contains three portraits of Talleyrand, one

after F. Gerard, one from a bust by Michelet, and one from an engraving by Napier. They have also ready "The Leaf-Collector's Hand-Book," by Charles P. Newhall, which is intended as an aid for students in classifying the leaves described in the author's former volume on "The Trees of North-eastern America," published last fall. A third volume on "The Shrubs of North-eastern America," is in preparation.

—The Century Company will publish George Kennan's "Siberia and the Exile System" this autumn. The book will appear simultaneously in England, France, Germany, and Holland. Unauthorized editions have already been published in Russia, Poland, Hungary, and Bulgaria, and many of the magazine articles have been reprinted in Italian and Swedish. Five unauthorized German editions have been issued.

—The Open Court Publishing Co. have issued a small book by Th. Ribot entitled "The Diseases of Personality," being a study of insanity and other abnormal and diseased conditions of body and mind. It partakes of the general character of recent French works in physiological psychology, but bears at the same time the marks of the author's individuality. It presents a large collection of facts relating to the theme of the book, and in that respect will be useful to all students of the subject; but the author's theories seem crude and unscientific. His idea of personality itself is vague and uncertain. Sometimes he speaks as if he thought personality the same thing as consciousness; but near the close of the

book he says that "the organism and the brain as its highest representation constitute the real personality" (p. 156). Elsewhere he speaks of the "dissolution of personality," and of the "transformation of the ego;" and again, in speaking of a man who is sometimes drunk and sometimes sober, he asks: "Have we not here, as it were, two incomplete and contrary individuals welded together in one common trunk?" Such notions indicate a strange aberration of judgment; and it is certainly not by theories of that sort that mental derangements can be explained.

—The Fleming H. Revell Company have ready the "Life of John Kenneth Mackenzie," medical missionary to China, written by Mrs. Bryson, who was an intimate friend of the doctor's from 1875 until his death in 1888, and worked with him in central China and afterwards on the banks of the Pei-ho.

—Professor John Fiske will open the September *Popular Science Monthly* with a paper on "The Doctrine of Evolution: its Scope and Influence;" and Herbert Spencer writes on "The Limits of State-Duties," in which he maintains that an industrial State should not attempt to mould artificially the minds and characters of its citizens. Continuing his Warfare of Science series, Dr. Andrew D. White will relate, in the same number, how hygiene succeeded feticism as the reliance of the Western world in checking the ravages of epidemics. A fifth paper, concerning "Glass in Science," will be added to the illustrated series on glass-making, by Professor C. H. Henderson, describing the making of spectacle-

A SYSTEM OF EASY LETTERING.

By J. H. CROMWELL, Ph.B.

Twenty-six different forms of Alphabets. The space to be lettered is divided into squares, and with these as a guide the different letters are drawn and inked. Price, 50 cents, postpaid.

E. & F. N. SPON, 12 Cortlandt Street, New York.

OF WHAT USE IS THAT PLANT?

You can find the answer in

SMITH'S "DICTIONARY OF ECONOMIC PLANTS."

Sent postpaid on receipt of \$2.80. Publisher's price, \$3.50.

SCIENCE BOOK AGENCY,

47 Lafayette Place, New York

THIRD EDITION.

THE FAULTS OF SPEECH

BY

A. MELVILLE BELL,

Author of "Visible Speech," etc., etc.

The Faults of Speech is a Self-Corrector and Teacher's Manual, for the removal of all Impediments and Defects of Articulation.

60 Cents.

* * Sent postpaid on receipt of price,

N. D. C. HODGES, 47 Lafayette Place, N. Y.

BOOKS: How to Exchange them for others. Send a postal to the SCIENCE exchange column (insertion free), stating briefly what you want to exchange. SCIENCE, 47 Lafayette Place, New York.

"The Week, one of the ablest papers on the continent."—*Descriptive America.*

THE WEEK,

A Canadian Journal of Politics, Literature, Science and Art.

PUBLISHED EVERY FRIDAY.

\$3.00 per Year. \$1.00 for Four Months.

THE WEEK has entered on its EIGHTH year of publication, greatly improved in every respect, rendering it more worthy the cordial support of every one interested in the maintenance of a first-class literary journal.

The independence in politics and criticism which has characterized THE WEEK ever since its first issue will be rigidly maintained; and unceasing efforts will be made to improve its literary character and increase its attractiveness as a journal for the cultured home. Many new and able writers are now, or have promised to become, contributors to its columns, and the constant aim of the Publisher will be to make THE WEEK fully equal to the best literary journals in Britain and the United States.

As heretofore, PROF. GOLDWIN SMITH will, from time to time, contribute articles. London, Paris, Washington and Montreal letters from accomplished correspondents will appear at regular intervals. Special Ottawa Letters will appear during the sessions of Parliament.

THE WEEK being the same size as "Harper's Weekly," is the largest paper of its class on the continent.

SEND FOR FREE SAMPLE COPY.

C. BLACKETT ROBINSON, Publisher,
5 Jordan St., Toronto, Canada.

THE AMERICAN GEOLOGIST FOR 1891 AND BIEN'S NEW ATLAS OF THE METROPOLITAN DISTRICT,

will be given to **New Subscribers** to the GEOLOGIST for \$25.00 (which is the regular price of the Atlas alone), if ordered through the GEOLOGIST.

For other premiums see the GEOLOGIST for Nov., Dec., and Jan. Address

THE GEOLOGICAL PUBLISHING COMPANY,
Minneapolis, Minn.

THE BOTANICAL GAZETTE.

A monthly illustrated journal of botany in all its departments.

25 cents a number, \$2.50 a year.

Address PUBLISHERS BOTANICAL GAZETTE,
Crawfordsville, Ind.

Publications of the University of Pennsylvania.

SERIES IN

Philology, Literature and Archæology.

Vol. I. now ready.

1. Poetic and Verse Criticism of the Reign of Elizabeth. By Felix E. Schelling, A.M., Assistant Professor of English Literature. \$1.00.
2. A Fragment of the Babylonian "Dibbarra" Epic. By Morris Jastrow, Jr., Ph.D., Professor of Arabic. 60 cents.
3. a. Ἰπὸς with the Accusative. b. Note on a Pas, sage in the Antigone. By William A. Lamberton A.M., Professor of the Greek Language and Literature. 50 cents.
4. The Gambling Games of the Chinese in America. Fán tán and Pák kóp piú. By Stewart Culin, Secretary of the Museum of Archæology and Palæontology. 40 cents.

In preparation.

The Terrace at Persepolis. By Morton W. Easton, Ph.D., Professor of Comparative Philology.
An Aztec Manuscript. By Daniel G. Brinton, M.D., Professor of American Archæology and Linguistics.

A Monograph on the Tempest. By Horace Howard Furness, Ph.D., LL.D.

Recent Archæological Explorations in New Jersey. By Charles C. Abbott, M.D., Curator of the American Collections.

Archæological Notes in Northern Morocco. By Talcott Williams, A.M., Secretary of the Museum of Egyptian Antiquities.

a. On the Aristotelian Dative. b. On a Passage in Aristotle's Rhetoric. By William A. Lamberton, A.M., Professor of the Greek Language and Literature.

A Hebrew Bowl Inscription. By Morris Jastrow, Jr., Ph.D., Professor of Arabic.

The Life and Writings of George Gascoigne. By Felix E. Schelling, A.M., Assistant Professor of English Literature.

The Papers of this Series, prepared by Professors and others connected with the University of Pennsylvania, will take the form of Monographs on the subjects of Philology, Literature, and Archæology, whereof about 200 or 250 pages will form a volume.

The price to subscribers to the Series will be \$1.50 per volume; to others than subscribers, \$2.00 per volume.

Each Monograph, however, is complete in itself, and will be sold separately.

It is the intention of the University to issue these Monographs from time to time as they shall be prepared.

Each author assumes the responsibility of his own contribution.

N. D. C. HODGES,

47 Lafayette Place, New York, N. Y.

BOOKS: How to get them. If there is any book or pamphlet that you want, write to the Science Book Agency, 47 Lafayette Place, New York.

glasses, the grinding of lenses for telescopes, the blowing and graduating of thermometer-tubes, the making of hydrometers, etc.; and the question "Can we always count upon the Sun?" is asked, though not in any sensational manner, by Mr. Garrett P. Serviss. The sun-spot period now approaching its maximum makes this query very timely.

— Henry Carey Baird & Co. have just issued a complete treatise on "The Electro-Deposition of Metals," translated from the German of Dr. George Langbein, with additions by William T. Brannt, editor of "The Techno-Chemical Receipt-Book."

— The "Manual of the Paleontology of the Cincinnati Group," by Joseph F. James, Part 1 (Journal Cincinnati Society Natural History, April, 1891, issued July, 1891), is part one of what is designed to be a manual of the fossils of lower silurian age in the vicinity of Cincinnati. The necessity of some such work as this will be better understood when the fact is recalled that the five or

six hundred species of fossils known from the locality are described in many different publications, such as State surveys, reports of societies, and scientific journals, extending over many years. The reports of the Ohio and New York surveys contain many, but by no means all, of the species. If the plan of the present publication be carried out, it will include descriptions of all genera and species recorded from the Cincinnati formation. The present, the first part, treats of *Plantæ* and *Protozoa*. The author does not believe the so-called marine plants described from the formation are really such, but refers them to inorganic causes, markings of organisms, annelid trails, etc. Two species of Heterophyta (*Cryptogamia*) are described, one of which, however, is considered problematical. The *Protozoa* include two orders, *Foraminifera* and *Spongida*. Of the first one genus and two species are described, and of the second fourteen genera and nineteen species. Two new species, *Rhombodictyon globosus* and *Cyathophycus siluriana*, are described and illustrated.

Exhaustion

Horsford's Acid Phosphate.

The phosphates of the system are consumed with every effort, and exhaustion usually indicates a lack of supply. The Acid Phosphate supplies the phosphates, thereby relieving exhaustion, and increasing the capacity for labor. Pleasant to the taste.

Dr. A. N. KROUT, Van Wert, O., says:
"Decidedly beneficial in nervous exhaustion."

Dr. S. T. NEWMAN, St. Louis, Mo., says:
"A remedy of great service in many forms of exhaustion."

Descriptive pamphlet free.

Rumford Chemical Works, Providence, R. I.

Beware of Substitutes and Imitations.

CAUTION.—Be sure the word "Horsford's" is printed on the label. All others are spurious. Never sold in bulk.

POPULAR MANUAL OF VISIBLE SPEECH AND VOCAL PHYSIOLOGY.

For use in Colleges and Normal Schools. Price 50 cents
Sent free by post by

N. D. C. HODGES, 47 Lafayette Pl., N. Y.

PRIZE ESSAYS OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

Practical Sanitary and Economic Cooking Adapted to Persons of Moderate and Small Means. By MRS. MARY HINMAN ABEL. 12mo, 182 pp. Cloth, 40 cents.

No. 1. Healthy Homes and Foods for the Working-Class. By Professor C. Vaughan, M.D. Ann Arbor, Mich. 8vo, 62 pp. Paper, 10 cents.

No. 2. The Sanitary Conditions and Necessities of School-Houses and School-Life. By D. F. Lincoln, M.D., Boston, Mass. 8vo, 38 pp. 5 cents.

No. 3. Disinfection and Individual Prophylaxis against Infectious Diseases. By George M. Sternberg, M.D., Major and Surgeon U.S.A. 8vo, 40 pp. Paper, 5 cents.

No. 4. The Preventable Causes of Disease, Injury, and Death in American Manufactories and Workshops, and the Best Means and Appliances for Preventing and Avoiding Them. By George H. Ireland, Springfield, Mass. 8vo, 20 pp. Paper, 5 cents.

The four essays (Nos. 1, 2, 3, 4) in one volume of nearly two hundred large octavo pages, thoroughly indexed. Cloth, 50 cents.

N. D. C. HODGES, 47 Lafayette Place, New York.



Old and Rare Books.

BACK NUMBERS and complete sets of leading Magazines. Rates low. AM. MAG. EXCHANGE, Schoharie N.Y.

Speech Reading and Articulation Teaching.

By A. MELVILLE BELL.

Price, 25 Cents.

Practical Instructions in the Art of Reading Speech from the Mouth; and in the Art of Teaching Articulation to the Deaf.

[This Work—written at the suggestion of Miss Sarah Fuller, Principal of the Horace Mann School for the Deaf, Boston, Mass.—is, so far as known, the first Treatise published on "Speech Reading."]

From *Principals of Institutions for the Deaf*.

"Admirable in its conciseness, clearness and freedom from technicality."

"The simplicity and perfection of this little book."

"Full of exact and helpful observations."

"A very interesting and valuable work."

"The rules are clearly given and will be of great utility."

"Every articulation teacher should study it."

"A model of clearness and simplicity, without having any of the puzzling symbols that trouble the common mind. . . . The exercises given in speech-reading from the lips are especially interesting, and of great importance for the student of phonetics."

— *Modern Language Notes*.

* * The above work may be obtained, by order, through any bookseller, or post-free on receipt of price, from

N. D. C. HODGES,
47 Lafayette Place, New York.

AMERICAN HERO-MYTHS.

A Study in the Native Religions of the Western Continent.

By D. G. BRINTON, M.D. 8°. \$1.75.

THE CRADLE OF THE SEMITES.

By D. G. BRINTON, M.D., and MORRIS JASTROW, JR. Ph.D. 8°. 30 cents.

N. D. C. HODGES, 47 Lafayette Pl., New York.



DO YOU INTEND TO BUILD?

If you intend to build, it will be a mistake not to send for "SENSIBLE LOW-COST HOUSES," now arranged in three volumes. In them you will find perspective views, floor plans, descriptions, and estimates of cost for 105 tasteful, new designs for houses. They also give prices for complete Working Plans, Details, and Specifications, which enable you to build without delays, mistakes or quarrels with your builder, and which any one can understand. Vol. I. contains 35 copyrighted designs of houses, costing between \$500 and \$1800. Vol. II. contains 35 copyrighted designs, \$1800 to \$3000. Vol. III. contains 35 copyrighted designs, \$3000 to \$9000. Price, by mail, \$1.00 each, or \$3.00 for the set.

"COLONIAL HOUSES," a volume showing Perspectives and Floor Plans of houses arranged in the inimitable style of the Colonial Architecture, and having all modern arrangements for comfort. Price, \$2.00.

"PICTURESQUE HOUSES FOR FOREST AND SHORE"—This shows Perspectives and Floor Plans of new designs for Summer Cottages, which are romantic convenient, and cheap. Price, \$1.00, by mail.

N. D. C. HODGES, 47 Lafayette Place, New York.

A NEW MONTHLY THE INTERNATIONAL JOURNAL OF MICROSCOPY AND NATURAL SCIENCE.

THE JOURNAL OF THE
POSTAL MICROSCOPICAL AND WESLEY
NATURALISTS' SOCIETIES.

Edited by ALFRED ALLEN and Rev.
WILLIAM SPIERS.

CONTENTS OF JULY NUMBER:

Parasitic Fungi Affecting the Higher Animals.
The Distance of the Stars.
Infusoria, Protozoa, etc., Practical Methods of
Preparation.
The History of the Microscope.
Our Young Naturalists' Page—
A Curious Want of Fear in a Pair of Robins.
Leap Year.
Aspect of the Heavens—July, 1891.
Collectors' Notes for July.
Natural History Notes.
The Poison of Toads.
Effect of Light on Spines.
Protective Mimicry in Spiders.
The Phenomenon of Autotomy in Certain
Animals.
Wesley Scientific Society.
Reviews.

\$1.75 Per Year.

To *Science* subscribers, \$1.00 for one year.
" " " 50 cents for six mos.

Sample Copies 10 cents.

PSYCHE.

A Journal of Entomology, published monthly
by the Cambridge Entomological Club.
\$2.00 per year, \$5.00 per volume of three
years. Volume VI. began in January, 1891.
Back volumes for sale at \$5.00 each. Vol-
ume I. sold only in complete sets.

THE WINNIPEG COUNTRY;

OR,

ROUGHING IT WITH AN ECLIPSE PARTY.

BY

A. ROCHESTER FELLOW.

(S. H. SCUDDER.)

With thirty-two Illustrations and a Map.
12°. \$1.50.

"The story is a piquant, good-humored, entertain-
ing narrative of a canoe voyage. A neater, prettier
book is seldom seen."—*Literary World*.

"This is a sprightly narrative of personal inci-
dent. The book will be a pleasant reminder to
many of rough experiences on a frontier which is
rapidly receding."—*Boston Transcript*.

"The picture of our desolate North-western terri-
tory twenty-five years ago, in contrast with its
civilized aspect to-day, and the pleasant features of
the writer's style, constitute the claims of his little
book to present attention."—*The Dial*.

READY SOON.

THE LABRADOR COAST.

A Journal of two Summer Cruises to that
region; with notes on its early discovery,
on the Eskimo, on its physical geography,
geology and natural history, together with
a bibliography of charts, works and articles
relating to the civil and natural history of
the Labrador Peninsula.

By ALPHEUS SPRING PACKARD, M.D., Ph.D.
8°, about 400 pp., \$3.50.

NEW BOOKS. JUST PUBLISHED FOSSIL RESINS.

This book is the result of an attempt to
collect the scattered notices of fossil resins,
exclusive of those on amber. The work is of
interest also on account of descriptions given
of the insects found embedded in these long-
preserved exudations from early vegetation.

By CLARENCE LOWN and HENRY BOOTH.

12°. \$1.

THE AMERICAN RACE:

By DANIEL G. BRINTON, M.D.

"The book is one of unusual interest and value."—
Inter Ocean.

"Dr. Daniel G. Brinton writes as the acknowledged
authority of the subject."—*Philadelphia Press*.

"The work will be of genuine value to all who
wish to know the substance of what has been found
out about the indigenous Americans."—*Nature*.

"A masterly discussion, and an example of the
successful education of the powers of observation."
—*Philadelphia Ledger*.

Price, postpaid, \$2.

BY THE SAME AUTHOR. RACES AND PEOPLES.

"The book is good, thoroughly good, and will long
remain the best accessible elementary ethnography
in our language."—*The Christian Union*.

"We strongly recommend Dr. Brinton's 'Races
and Peoples' to both beginners and scholars. We
are not aware of any other recent work on the
science of which it treats in the English language."
—*Asiatic Quarterly*.

"His book is an excellent one, and we can heartily
recommend it, as an introductory manual of ethnol-
ogy."—*The Monist*.

"A useful and really interesting work, which de-
serves to be widely read and studied both in Europe
and America."—*Brighton (Eng.) Herald*.

"This volume is most stimulating. It is written
with great clearness, so that anybody can under-
stand, and while in some ways, perforce, superficial,
grasps very well the complete field of humanity."
—*The New York Times*.

"Dr. Brinton invests his scientific illustrations and
measurements with an indescribable charm of nar-
ration, so that 'Races and Peoples,' avowedly a re-
cord of discovered facts, is in reality a strong stim-
ulant to the imagination."—*Philadelphia Public
Ledger*.

"The work is indispensable to the student who re-
quires an intelligent guide to a course of ethno-
graphic reading."—*Philadelphia Times*.

Price, postpaid, \$1.75.

THE MODERN MALADY; or, Suf- ferers from 'Nerves.'

An introduction to public consideration,
from a non-medical point of view, of a con-
dition of ill-health which is increasingly
prevalent in all ranks of society. In the
first part of this work the author dwells on
the errors in our mode of treating Neuras-
thenia, consequent on the wide ignorance of
the subject which still prevails; in the sec-
ond part, attention is drawn to the principal
causes of the malady. The allegory forming
the Introduction to Part I. gives a brief his-
tory of nervous exhaustion and the modes of
treatment which have at various times been
thought suitable to this most painful and try-
ing disease.

By CYRIL BENNETT.

12°, 184 pp., \$1.50.

READY SOON.

THE RADIOMETER.

By DANIEL S. TROY.

This will contain a discussion of the reasons
for their action and of the phenomena pre-
sented in Crookes' tubes.

Fact and Theory Papers

I. THE SUPPRESSION OF CON- SUMPTION. By GODFREY W. HAMBLETON, M.D. 12°. 40c.

"The inestimable importance of the subject, the
eminence of the author, and the novelty of his work,
all combine to render the little treatise worthy of
special consideration. . . . We heartily commend
Dr. Hambleton's booklet, and wish there were more
such works."—Editorial, *Boston Daily Advertiser*.

"The monograph is interesting in style, scholarly
and well worthy of careful consideration. It is de-
void of technical expressions, and can be easily read
and digested."—*Pharmaceutical Era*.

II. THE SOCIETY AND THE 'FAD.' By

APPLETON MORGAN, Esq. 12°. 20 cents.

"Mr. Morgan founds a sensible and interesting
address upon a text furnished by a sentence from
a young ladies' magazine; namely, 'Browning and
Ibsen are the only really dramatic authors of their
century.'"—*New York Sun*.

III. PROTOPLASM AND LIFE. By

C. F. COX. 12°. 75 cents.

"To be commended to those who are not special-
ists."—*Christian Union*.

"Physicians will enjoy their reading, and find in
them much food for thought."—*St. Louis Medical
and Surgical Journal*.

"Mr. Cox reviews the history of his subject with
knowledge and skill."—*Open Court*.

"It is of extreme interest."—*Medical Age*.

"Worthy of a careful perusal."—*Indiana Medical
Journal*.

"An interesting and popular account of the ten-
dencies of modern biological thought."—*Popular
Science News*.

"All interested in biological questions will find
the book fascinating."—*Pharmaceutical Era*.

"The author displays a very comprehensive grasp
of his subject."—*Public Opinion*.

"Deserves the attention of students of natural
science."—*Critic*.

IV. THE CHEROKEES IN PRE-CO- LUMBIAN TIMES. By CYRUS THOMAS. 12°. \$1.

Dr. Thomas has already presented to the public
some reasons for believing the Cherokees were
mound-builders, but additional evidence bearing
on the subject has been obtained. A more careful
study of the Delaware tradition respecting the Tal-
legwi satisfies him that we have in the Bark Record
(Walam Olum) itself proof that they were Chero-
kees. He thinks the mounds enable us to trace back
their line of migration even beyond their residence
in Ohio to the western bank of the Mississippi. The
object is therefore threefold: 1. An illustration of
the reverse method of dealing with prehistoric sub-
jects; 2. Incidental proof that some of the Indians
were mound-builders; 3. A study of a single tribe in
the light of the mound testimony. This work will be
an important contribution to the literature of the
Columbian discovery which will doubtless appear
during the coming two years.

"A valuable contribution to the question, 'Who
were the mound-builders?'"—*New York Times*.

"Professor Cyrus Thomas undertakes to trace
back the evidences of a single Indian tribe into the
prehistoric or mound-building age."—*N. Y. Sun*.

"An interesting paper."—*Christian Union*.

V. THE TORNADO. By H. A. HAZEN.

12°. \$1.

"The little book is extremely interesting."—*Bos-
ton Transcript*.

"A book which will find many readers. The
chapter on 'Tornado Insurance' is of interest to
all property-holders in the tornado States."—*Boston
Herald*.

"The 'Tornado' is a popular treatise on an impor-
tant province of meteorology. In which science, the
author, Professor Hazen of the United States Signal
Service, may be regarded as an expert."—*Philadel-
phia Ledger*.

VI. TIME-RELATIONS OF MENTAL PHENOMENA. By JOSEPH JASTROW. 12°. 50c.

"All students of psychology will find the book full
of interesting facts. Professor Jastrow's good qual-
ities as a thinker and as a writer are too well and
too widely known to require comment."—*Public
Opinion*.

"A useful work for psychologists—as well as the
general reader—by setting forth in brief and easily
intelligible form the present state of knowledge in
regard to the time required for the performance of
mental acts."—*The Critic*.

VII. HOUSEHOLD HYGIENE. By

MARY TAYLOR BISSELL. 12° 75 cents.

"A sensible brochure."—*Brooklyn Eagle*.

"Practical and sensible."—*Public Opinion*.

"The advice and excellent information which it
contains are tersely and intelligently expressed."—
Boston Medical and Surgical Journal.

"Practical and simply written."—*Springfield Re-
publican*.

"The best monograph on home hygiene."—*St.
Louis Globe-Democrat*.

In Preparation.

VIII. THE FIRST YEAR OF CHILD- HOOD. By J. MARK BALDWIN.

N. D. C. HODGES, 47 Lafayette Place, New York.